

# An End-To-End Microfluidic Platform for Engineering Life Supporting Microbes in Space Exploration Missions, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



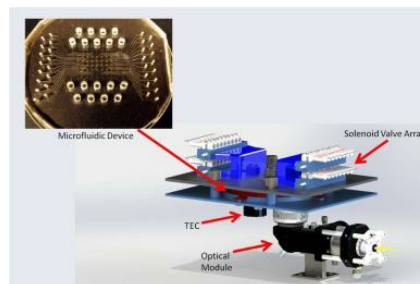
## ABSTRACT

HJ Science & Technology (HJS&T) and Lawrence Berkeley National Laboratory (LBNL) propose a highly integrated, programmable, and miniaturized microfluidic automation platform capable of running rapid and complex synthetic biology and bioengineering processes for engineering life supporting microbes in space exploration missions. Our approach combines the microfluidic automation technology of HJS&T with the novel synthetic biology technologies of 1) combinatorial gene library generation, 2) host transformation, and 3) gene product screening at LBNL and the Joint BioEnergy Institute (JBEI). In Phase I, we have established the feasibility of the proposed microfluidic automation technology by engineering and screening cyanobacterial cells for enhanced production of free fatty acids. In Phase II, we will expand the Phase I microfluidic automation capability to enable automated, metabolic engineering and screening of microbes for enhanced production of other classes of important compounds for in situ resource utilization in NASA space exploration missions: propellant fuels, biopolymers, and pharmaceuticals. We will also build and deliver a Phase II prototype. The successful development of the microfluidic automation technology with its automated and miniaturized platform will lay the groundwork for life supporting waste management and in situ resource utilization capabilities in future NASA manned space exploration missions.

## ANTICIPATED BENEFITS

### To NASA funded missions:

Potential NASA Commercial Applications: Microfluidic automation technology for synthetic biology offers significant opportunities for the development of life sustaining biological systems for long term space exploration missions. Among the potential applications are enhanced production of food and fuels from photosynthetic organisms, processing of waste products

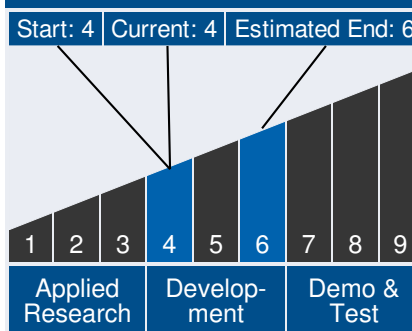


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## Technology Maturity



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such as CO<sub>2</sub> or urea, atmosphere regeneration, and water re-utilization as a part of environmental control and life support on the International Space Station. By engineering with new or enhanced metabolic pathways for the production or processing of chemical resources or waste, photosynthesis using cyanobacteria can be a particularly effective mechanism for environmental control and life support.

## To the commercial space industry:

Potential Non-NASA Commercial Applications: Synthetic biology offers significant advancements in a broad range of commercial applications including biofuel production, drug development, and agricultural development. The utility of our microfluidic technology in diverse fields is further enhanced by the development of automation procedures for a suite of organisms including cyanobacteria, *E. coli*, and yeast. As such, the proposed technology could be used in engineering biological processes such as mass producing effective medications, manufacturing specialty chemicals, engineering organisms and enzymes for better biofuel production, or developing crops that are more resistant to pathogens or drought. Generating and screening multiple combinations of genes, enzymes, and other biological parts is also vital to biotechnology research and development.

## Management Team

### Program Executives:

- Joseph Grant
- Laguduva Kubendran

### Program Manager:

- Carlos Torrez

### Principal Investigator:

- Erik Jensen

## Technology Areas

### Primary Technology Area:

Human Exploration Destination Systems (TA 7)

- └ In-Situ Resource Utilization (TA 7.1)
  - └ Processing and Production (TA 7.1.3)
    - └ Biological Technology (TA 7.1.3.17)

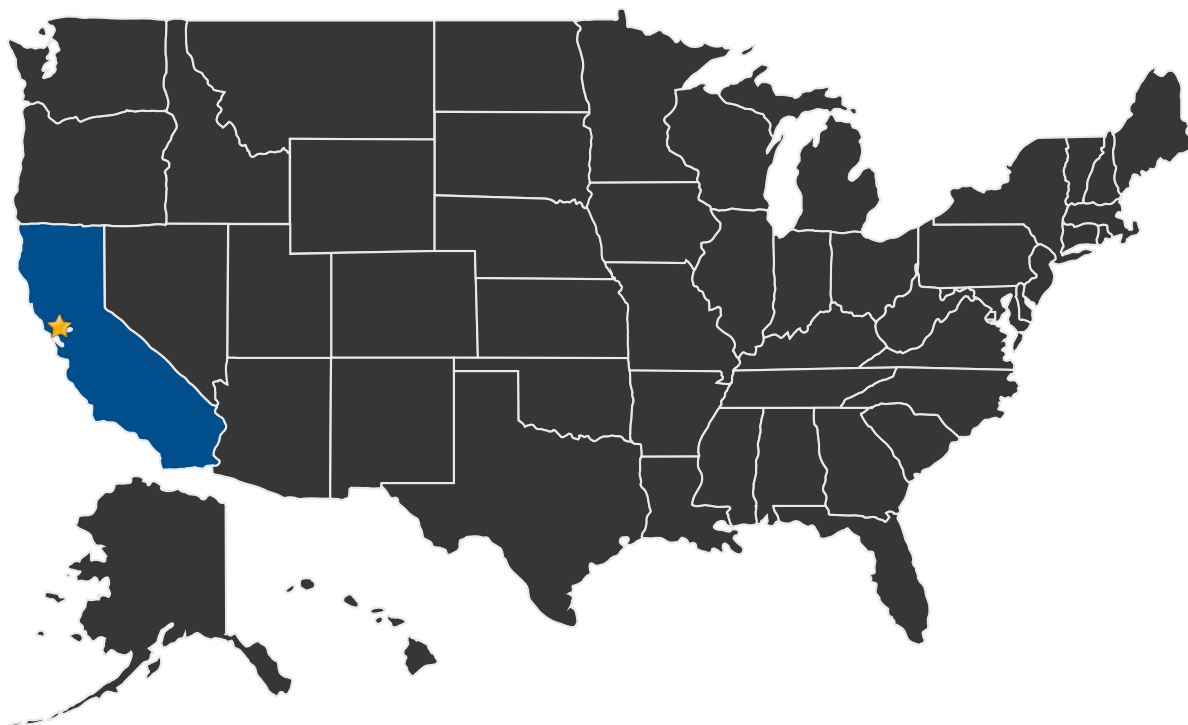
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## U.S. WORK LOCATIONS AND KEY PARTNERS

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■ U.S. States With Work      ★ **Lead Center:**  
Ames Research Center

### Other Organizations Performing Work:

- HJ Science & Technology, Inc. (Berkeley, CA)
- Lawrence Berkeley National Laboratory (Berkeley, CA)

## PROJECT LIBRARY

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### Presentations

- Briefing Chart
  - (<http://techport.nasa.gov:80/file/17726>)

Active Project (2015 - 2017)

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## DETAILS FOR TECHNOLOGY 1

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### Technology Title

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